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DRAWINGS ATTACHED

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(54) FLOW MEASURING DEVICE

(71) I, ROBERT EUGENE CLEARY, a citizen of the United States of America, of 5317 De Milo Street, Houston, Texas 77018, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to flow-measuring devices and more particularly to devices in which the rate of fluid flow is determined by measuring a differential pressure between two points having different flow cross-sections.

Known flow measuring devices have presented problems in head losses, friction losses, and acceptable performance when abrasive, semi-solid, and solid impurities are in the flowing medium.

In accordance with the present invention there is provided a device for measuring fluid flow rates comprising a flow passage of progressively increasing cross-section in the direction of fluid flow and a differential pressure measuring device having one side connected to a tap opening into the said flow passage between its ends.

Preferably the device comprises a second flow passage downstream of the first flow passage and having a progressively reducing cross-section in the direction of fluid flow, the other side of the differential pressure measuring device being connected to a tab opening into the second flow passage between its ends.

An embodiment of the invention to be described below is characterised by ease of fabrication, low manufacturing cost, and general availability of the components used. It has low head loss, low friction loss, complete reversibility, and acceptability of a flowing medium which contains abrasive, semi-solid or solid impurities in such flowing medium, it is accurate to within about one-half of one percent (½ of 1%) of the volume-measured. No projection into the fluid stream is necessary and no restriction is offered to the flow of the fluid stream. The device eliminates development of two phase flow problems which occur in devices which use restrictions or projections into the fluid stream.

The device to be described provides a differential pressure which may be used in mixing and batching operations where continuous flow exists through pipes, especially for corrosive fluids or fluids with impurities entrained where other devices are undesirable from a cost stand-point.

Briefly the device to be described is a flow measuring device wherein the rate of flow is derived from differential pressures in gaseous or liquid fluids by changes in the fluid velocity. Such device depends for its operation on the differential pressure produced between the upstream and downstream pressure taps. The difference in pressure results from the separation of the flowing medium from the wall of the curved part of a concentric reducer which is induced by the inherent velocity of the flow and as a result of the inertial forces present according to Newtonian Laws of Motion and the Bernioulli Principle. Additional differential is produced by the suction and impact effects of the flow at the manometer pressure taps. The flow measuring device is fabricated principally from well known and available components coacting in their effect to provide an unusual and unexpected result which allows the flow measuring device to maintain extreme accuracy and reliability.

In the drawings, the single figure is a partial cross-sectional plan view of a device incorporating the present invention.

Fluid flows in the direction of the arrow 10 through a pipe 12 having a coupling 14 welded to it at 16. An opening 18 in the pipe 12 communicates with a pressure gauge 20 well known in the art.

A concentric reducer 30 or similarly formed section is welded at 32 to the pipe 12. The concentric reducer 30 provides an increased volume near portions 34 and 36. It will be appreciated by those skilled in the art of fluid measurement that the concentric reducer shown and described in connection with the present invention is merely a representative

configuration and other forms and configurations may be used if the proper curvature is embodied therein. Concentric reducer 30 has an opening 38 extending into coupling 40 which is welded at 42 to concentric reducer 30. Threadedly coupled to the coupling 40 is line 44 of a manometer 50 having tubes 52 and 54 forming a U-shape. Disposed in the U-shape portion of manometer 50 is water or mercury 56 which allows the manometer to operate in a well known manner.

Concentric reducer 30 is welded at 60 to a first weld neck flange 62. A second weld neck flange 64 is coupled to the first weld neck flange 62 by suitable fastening means such as 66 and 68. Positioned between the first weld neck flange 62 and the second weld neck flange 64 is a gasket 70. The fastening means 66 and 68 may be of the conventional bolt and nut type distributed circumferentially on weld neck flanges 62 and 64.

The diameter of the opening 72 of the first and second weld neck flanges 62 and 64 is substantially identical with the maximum opening of concentric reducer 30. The first weld neck flange 62 has a port 74 extending to a pressure gauge 76 which is threadedly coupled to a coupling 78. Coupling 78 is welded at 80 to the first weld neck flange 62 to that port 74 communicates with the pressure gauge 76.

The second weld neck flange 64 has a port 82 which communicates with a drain valve 84. A pressure gauge may be positioned where valve 84 is located. The valve 84 or the pressure gauge is threadedly coupled to a coupling 86 which is welded at 88 to provide communication between the port 82 and the valve 84 or the pressure gauge.

Welded at 90 to the second weld neck flange 64 is a concentric reducer 92 substantially identical to the first concentric reducer 30. The concentric reducer 92 is welded at 94 to pipe 12.

Concentric reducer 92 has a coupling 96 welded at 98 to the concentric reducer 92 to provide communication between port 100 and line 102 which is coupled to manometer tube 54.

Pipe 12 has an aperture or opening 104 which communicates with a pressure gauge 106. The pressure gauge 106 may be threadedly coupled to a coupling 108 which is welded at 110 to pipe 12.

Thus, from observing the drawing it will be appreciated that flow entering at 10 through pipe 12 prior to leaving pipe 12 at 116 passes through a flow measuring arrangement according to the present invention. At the concentric reducer 30 a suction effect is provided while at the concentric reducer 92 an increased pressure effect is provided which acts upon the manometer 50 through the low pressure tube 52 and high pressure tube 54. Well known laws of physics are followed at the concentric reducers to provide differential pressure. As mentioned previously, additional differential pressure is produced by the suction and increased-pressure effects of the flow which will be indicated by the manometer.

It will be appreciated that the manometer couplings 40 and 96 may be positioned at any angle perpendicular to the flow or to an angle parallel to the direction of flow if necessary. Computation of actual flow for each particular differential will follow the square laws in various well known hydraulic equations corrected for the numerous variables involved in measuring different mediums under different conditions. When testing the device of the present invention under controlled conditions data such as coefficients will enable actual flow to be obtained.

As seen in the drawing the reducers 30 and 92 are of tapering shape, each having a wall portion presenting a longitudinally smoothly curved, generally conical inside surface through which the ports 38 and 100 open at locations mediate the ends of the wall portions, whereby abrupt change in the direction of flow of fluid passing through the device is eliminated. By this construction the accuracy of the device is increased due to the substantial elimination of friction losses and eddying of the fluid caused by abrupt changes in diameter.

The device described is characterised by several commercially advantageous features, namely retention of commonly accepted methods well known in the trade related to the accumulation and recording of differential pressure data acquired to determine flow rates.

Also the device described will conform to presently accepted accounting methods instituted to comply with the requirements of regulatory agencies for retaining a record of flow through pipe lines.

WHAT I CLAIM IS:—

1. A device for measuring fluid flow rates comprising a flow passage of progressively increasing cross-section in the direction of fluid flow and a differential pressure measuring device having one side connected to a tap opening into the said flow passage between its ends.

2. A device as claimed in claim 1 comprising a second flow passage downstream of the first flow passage and having a progressively reducing cross-section in the direction of fluid flow, the other side of the differential pressure measuring device being connected to a tap opening into the second flow passage between its ends.

3. A device as claimed in claim 2 in which the first and second flow passages are connected by a chamber of uniform diameter equal to the largest diameter of each of the flow passages.

4. A device as claimed in claim 1, 2 or 3,

in which the differential pressure measuring device is a manometer.

5. A fluid flow meter substantially as described with reference to the accompanying drawing.

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1210710 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*